

APPENDIX E

CUMULATIVE AIR QUALITY IMPACT TECHNICAL SUPPORT DOCUMENT

CUMULATIVE AIR QUALITY IMPACT TECHNICAL SUPPORT DOCUMENT

As discussed in Section 4.5.4 of this EIS, an air quality impact assessment was conducted during preparation of the Wyoming *Final EIS and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project* (BLM 2003a) and the Montana *Statewide Oil and Gas Final EIS and Proposed Amendment of the Powder River and Billings RMPs* (BLM 2003b). These documents will be referred to as the “Wyoming PRB Oil and Gas Project EIS” and the “Montana Statewide EIS” in the following discussion. The air quality impact analysis was prepared to evaluate the impacts of proposed oil and gas development in northeastern Wyoming and southeastern Montana on air quality in the region. This air quality impact assessment included projected coal mining operations in the Wyoming and Montana PRB, and the results are therefore included in the cumulative impact section of this EIS and this appendix. The following technical support document describes the processes used to conduct the air quality impact assessment, and provides summaries of relevant analysis data:

Argonne National Laboratory, 2002, Technical Support Document - Air Quality Impact Assessment for the Montana Statewide Oil and Gas Final EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans and the Wyoming Final EIS and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Montana and Wyoming State Offices, by the Environmental Assessment Division, Argonne National Laboratory. Argonne, Illinois.

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Introduction

Air pollution impacts are limited by local, state, tribal, and federal air quality regulations, standards, and implementation plans established under the CAA and administered by the WDEQ/AQD and the EPA. Although not applicable to the Alternatives analyzed in the Wyoming PRB Oil and Gas Project EIS or this EIS, the MDEQ/AWM has similar jurisdiction over potential air pollutant emission sources in Montana, which can have a cumulative impact with WDEQ/AQD approved sources.

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e., well operations, booster [field] and pipeline [sales] compressor engines, etc.), are potential causes of air quality impacts related to oil and gas development. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The USDA-FS, NPS, and USFWS have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within distant downwind PSD Class I and PSD Class II sensitive areas under their administration, located throughout Wyoming, Montana, southwestern North Dakota, western South Dakota, and northwestern Nebraska.

Existing Air Quality

The Project Area for the Wyoming PRB Oil and Gas Project EIS includes Campbell, Sheridan, Johnson, and northern Converse Counties. The Project Area for the Montana Statewide EIS includes all of Carter, Powder River, Big Horn, Yellowstone, Carbon, Stillwater, Sweetgrass, Wheatland, Golden Valley, Musselshell, and Treasure Counties, and portions of Rosebud and Custer Counties. The General Analysis Area for the South PRB Coal EIS is located in southern Campbell and northern Converse Counties, Wyoming, which lies in the southeastern portion of the Project Area for the Wyoming PRB Oil and Gas Project EIS.

Specific air quality monitoring is not conducted throughout most of the Project Area for the Wyoming PRB Oil and Gas Project EIS and the Montana Statewide EIS, but air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations. As part of the Air Quality Impact Assessment prepared by Argonne National Laboratory (Argonne 2002), monitoring data measured throughout northeastern Wyoming and southeastern Montana were assembled and reviewed. Although monitoring is primarily conducted in urban or industrial areas, the data selected are considered to be the best available representation of background air pollutant concentrations throughout the Project Area. Specific values presented in Table E-1 were used to define

background conditions in the air quality impact analysis. The assumed background pollutant concentrations are below applicable ambient air quality standards for all pollutants and averaging times. These National and Wyoming standards, and PSD increment values, are also presented in Table E-1.

Table E-1. Assumed Background Concentrations, Applicable Ambient Air Quality Standards, and PSD Increment Values (in $\mu\text{g}/\text{m}^3$).

| Pollutant | Averaging Time ^a | Background Concentration | National Ambient Air Quality Standards | Wyoming Ambient Air Quality Standards | PSD Class I Increment | PSD Class II Increment |
|-------------------|-----------------------------|--------------------------|--|---------------------------------------|-----------------------|------------------------|
| carbon monoxide | 1-hour | 3,500 ^b | 40,000 | 40,000 | --- | --- |
| | 8-hours | 1,500 ^b | 10,000 | 10,000 | --- | --- |
| lead | Quarterly | n/a | 1.5 | 1.5 | --- | --- |
| nitrogen dioxide | Annual | 16.5 ^c | 100 | 100 | 2.5 | 25 |
| ozone | 1-hour | 82 ^d | 235 | 235 | --- | --- |
| | 8-hours | 130 ^d | 157 | 157 | --- | --- |
| PM _{2.5} | 24-hours | 19 ^f | 65 | 65 | --- | --- |
| | Annual | 7.6 ^f | 15 | 15 | --- | --- |
| PM ₁₀ | 24-hours | 42 ^f | 150 | 150 | 8 | 30 |
| | Annual | 17 ^f | 50 | 50 | 4 | 17 |
| sulfur dioxide | 3-hours | 8 ^e | 1,300 | 1,300 | 25 | 512 |
| | 24-hours | 8 ^e | 365 | 260 | 5 | 91 |
| | Annual | 3 ^e | 80 | 60 | 2 | 20 |

^a Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.

^b Amoco Ryckman Creek collected for an 8 month period during 1978-1979, summarized in the Riley Ridge EIS (BLM 1983).

^c Data collected in Gillette, Wyoming (1996 – 1997).

^d Data collected in Pinedale, Wyoming (1992 – 1994).

^e Data collected at Devil's Tower (1983).

^f Data collected in Gillette, Wyoming (1999).

n/a – data not available

Regulatory Framework

The NAAQS and WAAQS set the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The analysis of the proposed alternatives must demonstrate continued compliance with all applicable local, state, tribal, and federal air quality standards. Existing air quality throughout most of the Project Area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS is in attainment with all ambient air quality standards, as demonstrated by the relatively low concentration levels presented in Table E-1. However, four areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Sheridan, Wyoming (PM₁₀ - moderate); and Billings (CO), Lame Deer (PM₁₀ - moderate), and Laurel (SO₂ - primary), Montana. EPA Region 8 staff are concerned that PM₁₀ monitoring data collected near and south of Gillette,

Wyoming, have also exceeded the NAAQS. Specific monitoring data are presented in Tables E-2 and E-3.

Table E-2. Annual Average PM₁₀ Monitoring Data Collected Near and South of Gillette, Wyoming (in µg/m³).

| Location | Station Number | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 ^a |
|-----------------------------|----------------|------|-------|--------|-------------------|----------------------|--------------------|-------------------|
| Rochelle R0-1 | 869 | n/a | n/a | [15.3] | 24.2 | 20.2 | 22.6 | [25] ^b |
| North Rochelle E | 874 | n/a | n/a | n/a | [40] ^b | [51] ^{b, e} | [50] ^b | 33.5 ^d |
| Black Thunder BTM 26-2 | 877 | 21.0 | 17.7 | 23.2 | 33.4 | 30.9 | 25.6 | [30] ^b |
| Antelope Site 4 | 881 | n/a | 14.5 | 13.4 | 16.2 | 16.7 | 19.8 | [12] ^b |
| Triton Coal / Buckskin Mine | 884 | 11.5 | 12.6 | 12.1 | 12.0 | 17.6* | 18.3 | [16] ^b |
| Cordero Hv-2 | 885 | 14.3 | 15.3 | 15.1 | 14.5 | 26.0* | 24.3* | [30] ^b |
| Cordero Hv-3 | 889 | 11.9 | 10.9 | 10.4 | 9.7 | 17.1 | 19.8 | [14] ^b |
| Coal Creek Ccm 26 | 890 | 9.0 | 7.9 | 8.6 | 8.5 | 8.3 | [2.0] | n/a |
| Thunder Basin Coal / BTM | 891 | 13.8 | 12.0 | 14.4 | 17 ^b | 24.5 | 37 ^b | [57] ^b |
| Belle Ayr Ba-4, 5n, 5s | 892 | 15.5 | 14.6 | 14.2 | 15.0 | 20.1 | 25 ^b | [20] ^b |
| Jacob Ranch Site 4 | 894 | 28.3 | 24.3* | 25.1* | 35.4* | 35.9* | 19.6 ^c | 30.2 ^c |
| Dry Fork Coal Co | 896 | 13.8 | 13.0 | 10.5 | 9.3 | 10.8 | 13.2 | [13] ^b |
| Triton Coal / Gillette | 899 | 21.5 | 22.7 | 15.3 | 17.2 | 19.0* | 21.0 | [18] ^b |
| AMAX Eagle Butte Eb-5 | 900 | 12.5 | 10.6 | 11.6 | 11.7 | 15.0 | 15 ^b | [15] ^b |
| Jacob Ranch Site 5 | 905 | 15.0 | 14.6 | 15.1 | 20.5 | 21.3 | 29.2 ^c | 25.6 ^c |
| North Rochelle 1 | 907 | n/a | 20.6 | 18.4 | 38.6 | 46.8 | 50.8* ^e | 37.8 ^d |
| Black Thunder BTM 36-1 | 915 | n/a | n/a | n/a | n/a | [18] ^b | 26 ^b | [16] ^b |
| Gillette, Wyoming | 1002 | 16.1 | 16.7 | 17.6* | 19.1* | 20.7* | 19.9* | [17] ^b |

Source: EPA (2002a) unless noted otherwise.

^a Incomplete data year; values reported through July 1, 2002.

^b Supplemental data provided by (Payton 2002).

^c Data provided by Jacobs Ranch Coal Co. (2003).

^d Data from WDEQ/AQD (2003b).

^e WDEQ/AQD does not agree with EPA's calculated value. Refer to Appendix M, Comment Letter 11 and Comment Response No. 2 for explanation.

µg/m³ - micrograms per cubic meter.

n/a - data not available.

[data] - data in brackets are not reliable due to the small number of samples collected.

data* - starred data are combined from two or more samplers operating at the same location during the same year.

Air quality regulations require proposed new, or modified existing, air pollutant emission sources (including CBM compression facilities) undergo a permitting review before their construction can begin. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation. In addition, the U.S. Congress (through the CAA Section 116) authorized local, state, and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. Also, under both FLPMA and the CAA, BLM can not authorize any activity which would not conform to all applicable local, state, tribal, and federal air quality laws, regulations, standards, and implementation plans.

Given the current attainment status for most of the Project Area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS, future development projects which have the potential to emit more than 250 tpy of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tpy) would be required to undergo a site-specific regulatory PSD Increment Consumption analysis under the federal New Source Review

permitting regulations. Development projects subject to the PSD regulations may also be required by the applicable air quality regulatory agencies to incorporate additional emission control measures (including a BACT analysis and determination) to ensure protection of air quality resources, and demonstrate that the combined impacts of all PSD sources will not exceed the allowable incremental air quality impacts for NO₂, PM₁₀, and SO₂.

Table E-3. Second Maximum 24-hour Average PM₁₀ Monitoring Data Collected Near and South of Gillette, Wyoming (in µg/m³).

| Location | Station Number | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002^a |
|-----------------------------|-----------------------|-----------------|-------------|-------------|-----------------|-------------|------------------|-------------------------|
| Rochelle R0-1 | 869 | n/a | n/a | [23] | 62 | 46 | 63 | [55] ^b |
| North Rochelle E | 874 | n/a | n/a | | 122 | 143 | 156 ^b | [124] ^b |
| Black Thunder BTM 26-2 | 877 | 66 | 44 | 55 | 125 | 123 | 101 | [62] ^b |
| Antelope Site 4 | 881 | n/a | 32 | 32 | 35 | 50 | 54 | [25] ^b |
| Triton Coal / Buckskin Mine | 884 | 31 | 34 | 36 | 36 | 53* | 73 ^b | [43] ^b |
| Cordero Hv-2 | 885 | 32 | 36 | 42 | 36 | 73* | 65* | [55] ^b |
| Cordero Hv-3 | 889 | 30 | 22 | 25 | 26 | 46 | 47 | [40] ^b |
| Coal Creek Ccm 26 | 890 | 20 | 16 | 23 | 25 | 31 | n/a | n/a |
| Thunder Basin Coal / BTM | 891 | 34 | 26 | 39 | 43 ^b | 80 | 97 ^b | [155] ^b |
| Belle Ayr Ba-4, 5n, 5s | 892 | 39 | 34 | 53 | 56 | 48 | 70 ^b | [35] ^b |
| Jacob Ranch Site 4 | 894 | 101 | 62* | 54* | 103* | 88* | 119 ^b | n/a |
| Dry Fork Coal Co | 896 | 34 | 39 | 35 | 22 | 32 | 42 | [34] ^b |
| Triton Coal / Gillette | 899 | 85 | 65 | 37 | 45 | 54* | 80 ^b | [73] ^b |
| AMAX Eagle Butte Eb-5 | 900 | 30 | 37 | 37 | 51 | 48 | 61 | [36] ^b |
| Jacob Ranch Site 5 | 905 | 44 ^b | 39 | 43 | 47 | 50 | 97 | n/a |
| North Rochelle 1 | 907 | n/a | 39 | 49 | 100 | 125 | 268 ^b | [211] ^b |
| Black Thunder BTM 36-1 | 915 | n/a | n/a | n/a | n/a | [24] | 76 ^b | [31] ^b |
| Gillette, Wyoming | 1002 | 46 ^b | 29 | 36* | 42* | 60* | 43 ^b | [35] ^b |

Source: EPA (2002a)

^a Incomplete data year; values reported through July 1, 2002.

^b Supplemental data provided by (Payton 2002).

µg/m³ - micrograms per cubic meter.

n/a - data not available.

[data] - data in brackets are not reliable due to the small number of samples collected.

data* - starred data are combined from two or more samplers operating at the same location during the same year.

A regulatory PSD Increment Consumption analysis may be conducted as part of a New Source Review, or independently. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agencies, with EPA oversight. In addition, an analysis of cumulative impacts due to all existing sources and the permit applicant's sources is also required during New Source Review to demonstrate that applicable ambient air quality standards will be met during the operational lifetime of the permit applicant's operations.

Existing surface coal mining operations in the PRB are not currently affected by the PSD regulations for two reasons: surface coal mines are not on the EPA list of 28 major emitting facilities for PSD regulation, and point-source emissions from individual mines do not exceed the PSD emissions level of 250 tpy. A new mine would be classified as a major source and subject to PSD review if potential emission of any regulated pollutant equal or exceed 250 tpy. Fugitive emissions are not included in the definition of potential emissions except for certain specified source types (40 CFR 52.21 (b)(1)(iii)). Mining related fugitive emissions are exempt from the applicability determination.

Sources subject to the PSD permit review procedure are also required to demonstrate potential impacts to AQRVs. These include visibility impacts, degradation of mountain lakes from atmospheric deposition (acid rain), and effects on sensitive flora and fauna in the Class I areas. The CAA also provides specific visibility protection procedures for the mandatory federal Class I areas designated by the U.S. Congress on August 7, 1977, which included wilderness areas greater than 5,000 acres in size, as well as national parks and national memorial parks greater than 6,000 acres in size as of that date. The Fort Peck and Northern Cheyenne tribes have also designated their lands as PSD Class I, although the national visibility regulations do not apply in these areas. The allowable incremental impacts for NO₂, PM₁₀, and SO₂ within these PSD Class I areas are very limited. The remainder of the Project Area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS is designated PSD Class II with less stringent requirements.

Agency Roles and Authorities

EPA

The EPA administers the Federal CAA, (42 U.S.C. 7401 et seq.) to maintain the NAAQS that protect human health and to preserve the rural air quality in the region by assuring the PSD Class I and Class II increments for SO₂, NO₂, and PM₁₀ are not exceeded. EPA has delegated this CAA authority to the States of Montana and Wyoming.

Until the Tribes have an EPA-approved Tribal program, EPA will administer air quality requirements within Indian country. EPA is responsible for assuring that NAAQS are attained and that the Tribally-designated Northern Cheyenne Class I sensitive airshed is protected, as well as the Class II increment limits that apply on the Crow Reservation. EPA will implement an air permitting program for major sources within Indian country, including BACT analysis, where appropriate. At this time, there is no federal minor source permitting program. Therefore, EPA cannot regulate minor sources in Indian country directly unless EPA, based on the results of a PSD increment consumption model, decides to implement a Federal Implementation Plan (FIP). Based on future regulatory modeling in cooperation with MDEQ, EPA and BIA may require either of the two Tribes included in the Project Areas for the Wyoming Oil and Gas Project EIS and the Montana Statewide EIS (the Crow and the Northern Cheyenne Tribes) to apply BACM to unimproved roads in Indian country or other control measures sufficient to avoid exceeding the Class I and Class II increment limits for PM₁₀.

Wyoming DEQ

Wyoming regulates pollutants emitted into the air through the Wyoming Environmental Quality Act (W.S. 35-11-101 et. seq.). Wyoming is also authorized by an approved State Implementation Plan (SIP) to administer all requirements of the PSD permit program under the CAA. Additionally, the

approved Wyoming SIP contains a number of programs which provide for the implementation, maintenance, and enforcement of the NAAQS, including a New Source Review program for minor source permitting which requires, among other things, application of BACT for all new or modified sources regardless of size or source category. Included as well are authorities for the control of particulate emissions, including fugitive particulate emissions from haul roads, access roads, or general facility boundaries. Wyoming is also delegated responsibility to operate an approved ambient air quality monitoring network for the purpose of demonstrating compliance with the NAAQS and WAAQS.

Bureau of Land Management

NEPA requires that federal agencies consider mitigation of direct and cumulative impacts during their preparation of an EIS (BLM Land Use Planning Manual 1601). Under the CAA, federal agencies are to comply with State Implementation Plans regarding the control and abatement of air pollution. Prior to approval of RMPs or Amendments to RMPs, the State Director is to submit any known inconsistencies with SIPs to the Governor of that State. If the Governor of the State recommends changes in the proposed RMP or Amendment to meet SIP requirements, the State Director shall provide the public an opportunity to comment on those recommendations. (BLM Land Use Planning Manual at Section 1610.3-2.)

Forest Service

The USDA-FS administers nine wilderness areas (WAs) that could be affected by direct effects associated with the proposed development considered in the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS: Bridger WA; Fitzpatrick WA; North Absaroka, Absaroka-Beartooth, and Washakie WAs, next to Yellowstone National Park; Teton WA; and U.L. Bend WA, which have mandatory Class I designations; as well as Cloud Peak WA; and Popo Agie WA, which have Class II designations. As federal land managers, the USDA-FS could act in a consultative role to stipulate that the BLM modeling results, or any future EPA or State-administered PSD refined modeling results (if justified), triggers adverse impairment status. Should the USDA-FS determine impairment of WAs, then BLM, the State, and/or EPA may need to mitigate this predicted adverse air quality effect.

National Park Service

Three areas administered by the NPS, Yellowstone National Park, Devils Tower National Monument, and Bighorn Canyon National Recreation Area, could be affected by direct effects associated with the proposed development considered in the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS. As federal land managers, the Park Service could act in a consultative role to stipulate that the BLM modeling results, or any future EPA or State-administered PSD refined modeling results (if justified), triggers adverse impairment status. Should the Park Service determine impairment of NPS-

administered Class I areas, then BLM, the State, and/or EPA may need to mitigate this predicted adverse air quality effect.

Air Quality Impact Assessment

Sections 4.1.4.4 through 4.1.4.7 of this EIS discuss the air quality impact modeling results for the LBAs considered in this EIS. Section 4.5.4 of this EIS discusses the cumulative air quality impact assessment that was conducted for the Wyoming PRB Oil and Gas Project EIS and the Montana Statewide EIS. An extensive air quality impact assessment technical support document was also prepared by Argonne National Laboratory (Argonne 2002) and is available for review. Argonne analyzed potential impacts from: individual proposed Alternatives 1, 2A, 2B, and 3 of the Wyoming PRB Oil and Gas Project EIS; “Other” (non-Alternative) emission sources, including surface coal mining in the Wyoming and Montana PRB; and all sources cumulatively by alternative. Alternatives 1, 2A, and 2B of the Wyoming PRB Oil and Gas Project EIS have similar emission inventories, except half of the booster (field) compressors would be electrified under Alternative 2A, and all of the booster (field) compressors would be electrified under Alternative 2B.

The air quality impact assessment conducted for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS was based on the best available engineering data and assumptions, meteorology data, and dispersion modeling procedures, as well as professional and scientific judgment. However, where specific data or procedures were not available, reasonable assumptions were incorporated. For example, the air quality impact assessment assumed that the maximum CBM, conventional oil, coal, and other development would occur simultaneously, whereas actual development would occur under different time schedules.

Potential air pollutant emissions from the emission sources under the Proposed Action for the Wyoming PRB Oil and Gas Project EIS were combined with other (non-alternative) sources to determine the total potential cumulative air quality impacts. These other (non-alternative) sources included development associated with emission sources permitted: 1) by the WDEQ/AQD; 2) by the MDEQ/AWM; and 3) within the states of North Dakota, South Dakota, and Nebraska; plus 4) the Montana Statewide EIS alternative sources.

Potential direct, indirect, and cumulative air quality impacts from the Proposed Action and alternatives for the Wyoming PRB Oil and Gas Project EIS, and other (non-alternative) sources, including surface coal mining in the Wyoming and Montana PRB, were analyzed and reported solely under the requirements of NEPA, in order to assess and disclose reasonably foreseeable impacts to both the public and the BLM decision maker. Due to the preliminary nature of this NEPA analysis, it should be considered an estimate of predicted impacts. Actual impacts at the time of development (subject to air pollutant emission source permitting) are likely to be different.

Given the lack of representative wind measurements throughout the CBM emphasis area, the EPA CALPUFF dispersion model was used with regional wind speed and direction values derived from the 1996 MM5 (mesoscale model) and CALMET meteorological models (Argonne 2002). Meteorological information was assembled to characterize atmospheric transport and dispersion from several 1996 data sources, including: 36 km gridded MM5 (mesoscale model) values with continuous four-dimensional data assimilation; and hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation).

Potential air quality impacts were predicted using the EPA CALPUFF dispersion model. The meteorology data and air pollutant emission values were combined to predict maximum potential direct, indirect, and cumulative near-field air quality impacts in the vicinity of assumed CBM well and CBM pipeline compressor engine emission sources for comparison with applicable air quality standards and PSD Class II increments. Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad construction were used to predict the maximum annual and 24-hour average PM_{2.5}, PM₁₀, and SO₂ impacts. Maximum air pollutant emissions from each CBM well would be temporary (i.e., occurring during a 12-day construction period) and would occur in isolation, without significantly interacting with adjacent well locations. Particulate matter emissions from well pad and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was computed at 50 percent during construction. During well completion testing, natural gas could be burned (flared) up to 24 hours.

Air pollutant dispersion modeling was also performed to quantify CO, NO₂, PM_{2.5}, PM₁₀, and HAP impacts during operation. Operation emissions would primarily occur due to increased CBM pipeline compression requirements, including booster (field) and pipeline (sales) compressor stations. Since produced natural gas is nearly pure methane, with little or no liquid hydrocarbons or sulfur compounds, direct VOC emissions or objectionable odors are not likely to occur. HAP impacts were predicted based on an assumed 9,900 hp, six-unit, reciprocating compressor engine station operating at full load with emissions generated by a single stack.

The significance criteria for potential air quality impacts include local, state, tribal, and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. These requirements and legal limits were presented in Table E-1. Where legal limits have not been established, BLM uses the best available scientific information to identify levels of significant adverse impacts. Levels of potential adverse impacts have been identified for HAP exposure, potential ANC changes to sensitive lake water chemistry, and a 1.0 dv “just noticeable change” in potential visibility impacts.

Since neither the WDEQ/AQD nor EPA have established HAP standards, predicted eight-hour HAP concentrations were compared to a range of eight-hour state maximum Acceptable Ambient Concentration Levels (EPA 1997a). Pollutants which were predicted to exceed these state levels were also analyzed to determine the possible incremental cancer-risk for a most likely exposure (MLE) to residents, and to a maximally exposed individual (MEI), such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPA's unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job.

The EPA CALPUFF dispersion model was also used to determine maximum far-field ambient air quality impacts at downwind mandatory federal PSD Class I areas, and other sensitive receptors, to: 1) determine if the PSD Class I increments might be exceeded; 2) calculate potential total sulfur and nitrogen deposition, and their related impacts to in sensitive lakes; and 3) predict potential visibility impacts (regional haze) within distant sensitive receptors.

Several lakes within five USDA-FS designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The USDA-FS (Fox et al. 1989) has identified the following total deposition (wet plus dry) thresholds below which no adverse impacts are likely: five kg/ha-yr for sulfur, and three kg/ha-yr for nitrogen. The USDA-FS (2000) has also developed a screening method which identifies the following Limit of Acceptable Change regarding potential changes in lake chemistry: no more than a 10 percent change in ANC for those water bodies where the existing ANC is at or above 25 µeq/L and no more than a 1.0 µeq/L change for those extremely sensitive water bodies where the existing ANC is below 25 µeq/L. No sensitive lakes were identified by either the NPS or USFWS.

Since the potential air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to impact the distant sensitive areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light. Potential changes to regional haze are calculated in terms of a perceptible "just noticeable change" (1.0 dv) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 et seq.), and as originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding to a two to five percent change in contrast, for a black target against a clear sky, at the most optically sensitive distance from an observer), which is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory federal Class I areas.

It should be noted that a 1.0 dv change is not a “just noticeable change” in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as due to preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a “just noticeable change”. However, this NEPA analysis is not designed to predict specific visibility impacts for specific views in specific mandatory federal Class I areas based on specific project designs, but to characterize reasonably foreseeable visibility conditions that are representative of a fairly broad geographic region, based on emission source assumptions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. At the time of a pre-construction air quality PSD permit review, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of change, frequency, time of the year, and the meteorological conditions during times when predicted visibility impacts are above the 1.0 dv level should all be considered when assessing the significance of predicted impacts.

The USDA-FS, NPS, and USFWS have published their “Final FLAG Phase I Report” (Federal Register, Vol. 66 No. 2, dated January 3, 2001), providing “a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs” including visibility. For example, the FLAG report states “A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed”, and further, “If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10 percent (1.0 dv) for all time periods, the FLMs will not likely object to the proposed action”.

The FLAG report also recommends a two-step analysis process to evaluate potential visibility impacts from either a single proposed air pollutant emission source (the seasonal FLAG screening method) or potential cumulative visibility impacts from a group of air pollutant emission sources (the daily FLAG refined method). As described in Argonne (2002), this NEPA analysis first used the seasonal FLAG “natural background” screening method (based on both the FLAG and WDEQ/AQD reference levels) to exclude those sensitive areas where visibility impacts were not likely to occur. Since no areas were excluded using the seasonal FLAG screening method, this NEPA analysis then applied the daily FLAG refined method (based on hourly background optical extinction and relative humidity values measured in both the Badlands and Bridger wilderness areas between 1989 and 1999) to determine the average number of days a 1.0 dv “just noticeable change” would be reached annually in each sensitive area. Although the use of observed hourly optical extinction and relative humidity values is appropriate in this NEPA analysis (where the potential visibility impacts are predicted to occur based on the reasonably foreseeable background conditions), EPA’s Regional Haze Regulations are

based on optical conditions reconstructed from PM_{2.5} and PM₁₀ data collected every third day under the IMPROVE program.

Estimation of Emission Factors: AP-42

Air quality impacts for various air pollutants are determined by the use of air dispersion models using specific source emission rates. For natural gas compressors, the emissions of nitrogen oxides are determined by the assumed permitted emission rate allowed by the state. For fugitive dust impacts, emission rates are obtained from EPA's AP-42 document that is titled "Compilation of Air Pollutant Emission Factors". An AP-42 emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors may be appropriate to use in a number of situations such as making source-specific emission estimates for areawide inventories. These inventories have many purposes including ambient dispersion modeling and analysis, control strategy development, and in screening sources for compliance investigations. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all sources in a specific category.

Modeling Assumptions

When reviewing the predicted near- and far-field air quality impacts, it is important to understand that assumptions were made regarding development, emissions, meteorology, atmospheric transport and chemistry, and atmospheric deposition. For example, there is uncertainty regarding ultimate development of CBM in the Wyoming and Montana PRB (i.e., number of wells, equipment to be used, specific locations of wells, etc.).

The following assumptions were used in the analysis:

- Total predicted short-term air pollutant impact concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations, which may occur under different meteorological conditions.
- Assumed background air pollution concentrations were assumed to occur throughout the 20-year LOP at all locations in the region, even though monitoring is primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM₁₀ levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.
- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.

- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the LOP. Given the number of sources included in this analysis, the co-probability of such a scenario actually occurring over an entire year (or even 24-hours) is small.
- In developing the emissions inventory and model, there is uncertainty regarding ultimate oil and gas development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 percent) proposed CBM wells and 30 percent of conventional wells were assumed to be fully operational and remain operating (no shut-ins) throughout the LOP.
- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the LOP (no phased increases or reductions). In reality, compression equipment would be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings, and it is unlikely all compressor stations would operate at maximum levels simultaneously.
- The HAP analyses assumed a 9,900 hp, six-unit, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the LOP.
- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time. However, it is possible that conditions close to this could occur in some isolated areas.
- The emissions inventory and model assumed a NO_x emission rate for compressor engines of 1.5 g/hp-hr in Montana and 1.0 g/hp-hr in Wyoming. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Wyoming or Montana, and on Indian lands by EPA, for field and sales compressor engines. Actual NO_x emission rates may range from 0.7 to 2.0 g/hp-hr.
- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a “limit of acceptable change” is: a 10 percent change in acid neutralizing capacity (ANC) for lakes with a background ANC greater than 25 µeq/L; or a 1.0 µeq/L change in ANC for lakes with a background ANC less than 25 µeq/L, and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components

would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).

- The visibility impact analysis assumed that a 1.0 dv “just noticeable change” would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal, or federal regulatory visibility standards. However, some FLMs are using 0.5 dv as a screening threshold for significance.
- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100 percent) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50 percent reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level of effectiveness is characterized as the maximum possible. Wetting was assumed for maintenance traffic, which is not likely to occur, but this is considered to be a small effect because of limited traffic.
- Induced or secondary growth related to increases in vehicle miles traveled (VMT) (believed to be on the order of 10 percent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.
- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (meteorology, terrain, etc.) By not placing modeled receptors close to emission sources (e.g., wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.
- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBM and RFFD sources. Other existing increment consuming sources such as Campbell County coal mines were not included in this comparison, as the air quality analysis does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Monitoring data in Wyoming has indicated an upward trend in PM concentrations in Campbell County

since 1999, which coincides with CBM development but is also exacerbated by prolonged drought in the region.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the State, tribe, or EPA) would review specific air pollutant emissions preconstruction permit applications that examine potential project-specific air quality impacts. As part of these permit reviews (depending on source size), the air quality regulatory agencies could require additional air quality impact analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality.

Modeling Results

The following Tables (E-4 through E-17) present the detailed atmospheric dispersion modeling results for the alternatives considered in the Wyoming PRB Oil and Gas Project EIS. These results are summarized in Section 4.5.4 of this EIS. As discussed in Section 4.5.4, the cumulative impacts predicted by the PRB air quality impact assessment would be the same under the Proposed Action and all of the alternatives for leasing or not leasing federal coal considered in this EIS. This is because the air quality impact analysis used market demand predictions in order to estimate levels of coal production in the PRB for modeling purposes. There is enough coal leased to the existing mines in the PRB to supply this market demand during the time of maximum CBM development activity in the PRB, which is the time when the maximum overlapping impacts to air quality would occur.

| Table E-4. Predicted Hazardous Air Pollutant Impacts and State Acceptable Ambient Concentration Levels (in $\mu\text{g}/\text{m}^3$). | | | | | | |
|--|----------------|-----------------------|--|----------|--------|--------|
| Pollutant | Averaging Time | Direct Modeled Impact | Range of State Acceptable Ambient Concentration Levels | | | |
| | | | | | | |
| formaldehyde | 8-hours | 11.9 | 4.5 | (FL07) - | 71 | (NV01) |
| n-hexane | 8-hours | 0.6 | 1,800 | (FL07) - | 36,000 | (CT01) |
| benzene | 8-hours | 0.7 | 30 | (FL04) - | 714 | (NV01) |
| toluene | 8-hours | 4.6 | 1,870 | (IN03) - | 8,930 | (NV01) |
| ethyl benzene | 8-hours | < 0.1 | 4,340 | (ND01) - | 43,500 | (VT01) |
| xylene | 8-hours | 0.2 | 2,170 | (IN01) - | 10,400 | (NV01) |
| Agencies: | | | | | | |
| CT01 - Connecticut Department of Environmental Protection; Air Compliance Unit | | | | | | |
| FL04 - Broward County Department of Natural Resource Protection (Florida) | | | | | | |
| FL07 - Pinellas County Air Pollution Control Board (Florida) | | | | | | |
| IN01 - Indiana Department of Environmental Management | | | | | | |
| IN03 - Indianapolis Air Pollution Control Division (Indiana) | | | | | | |
| ND01 - North Dakota Dept. of Health; Division of Environmental Engineering | | | | | | |
| NV01 - Nevada Division of Environmental Protection; Air Quality Control | | | | | | |
| VT01 - Vermont Dept of Environmental Conservation; Air Pollution Control Division | | | | | | |

Table E-5. Wyoming PRB Oil and Gas Project EIS Alternative 1 - Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$).

| Pollutant | Avg Time ^a | Location | Increment | Alt 1 | Other | Cum | Background | Total | National | Wyoming |
|-------------------|-----------------------|------------------------|-----------|-------|-------------------------|--------------------------|------------|-------|----------|---------|
| carbon monoxide | 1-hour | near-field | - - - | 223 | 142 | 224 | 3,500 | 3,724 | 40,000 | 40,000 |
| | | far-field ¹ | - - - | 5 | 100 | 100 | 3,500 | 3,600 | 40,000 | 40,000 |
| | 8-hours | near-field | - - - | 156 | 124 | 156 | 1,500 | 1,656 | 10,000 | 10,000 |
| | | far-field ² | - - - | 19 | 70 | 78 | 1,500 | 1,578 | 10,000 | 10,000 |
| nitrogen dioxide | Annual | near-field | 25 | 8.0 | 3.3 | 10.5 | 17 | 27 | 100 | 100 |
| | | far-field ³ | 25 | 0.4 | 5.1 | 5.4 | 17 | 22 | 100 | 100 |
| | | far-field ² | 2.5 | 0.3 | 3.9 ^b | 4.2 ^b | 17 | 21 | 100 | 100 |
| PM _{2.5} | 24-hours | near-field | - - - | 16.0 | 8.6 | 24.4 | 19 | 43 | 65 | 65 |
| | | far-field ³ | - - - | 5.1 | 9.7 | 14.7 | 19 | 34 | 65 | 65 |
| | Annual | near-field | - - - | 1.7 | 0.7 | 2.3 | 8 | 10 | 15 | 15 |
| | | far-field ³ | - - - | 0.2 | 1.1 | 1.2 | 8 | 9 | 15 | 15 |
| PM ₁₀ | 24-hours | near-field | 30 | 20.2 | 9.3 | 30.8 ^b | 42 | 73 | 150 | 150 |
| | | far-field ⁴ | 30 | 0.5 | 29.7 | 29.7 | 42 | 72 | 150 | 150 |
| | | far-field ² | 8 | 3.9 | 9.4 ^b | 12.8 ^b | 42 | 55 | 150 | 150 |
| | | far-field ⁵ | 8 | 2.2 | 7.0 | 9.2 ^b | 42 | 51 | 150 | 150 |
| | Annual | near-field | 17 | 3.3 | 0.9 | 4.1 | 17 | 21 | 50 | 50 |
| | | far-field ⁴ | 17 | <0.1 | 2.7 | 2.7 | 17 | 20 | 50 | 50 |
| | | near-field | 512 | 3.3 | 4.5 | 4.6 | 8 | 13 | 1,300 | 1,300 |
| sulfur dioxide | 3-hours | far-field ³ | 512 | 0.7 | 17.1 | 17.1 | 8 | 25 | 1,300 | 1,300 |
| | | near-field | 91 | 1.7 | 1.8 | 3.2 | 8 | 11 | 365 | 260 |
| | 24-hours | far-field ³ | 91 | 0.3 | 5.3 | 5.3 | 8 | 13 | 365 | 260 |
| | | near-field | 20 | 0.5 | 0.2 | 0.6 | 3 | 4 | 80 | 60 |
| | Annual | near-field | 20 | 0.5 | 0.2 | 0.6 | 3 | 4 | 80 | 60 |
| | | far-field ³ | 20 | <0.1 | 0.4 | 0.4 | 3 | 3 | 80 | 60 |

^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 1 - Direct modeled Wyoming PRB Oil and Gas EIS Alternative 1 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

Table E-6. Wyoming PRB Oil and Gas Project EIS Alternative 1 - Predicted Atmospheric Deposition Impacts and Applicable Significance Guidelines.

| Location | PSD Class | Lake | Total Sulfur Deposition (kg/ha-yr) | | | | Total Nitrogen Deposition (kg/ha-yr) | | | | Bkgd (µeq/L) | Acid Neutralizing Capacity (percent) | | | |
|---------------------------|-----------|-----------------|---------------------------------------|-------|------|------|---|-------|------|------|------------------|---|------------------------|-------------------------|-----------------|
| | | | Alt 1 | Other | Cum | Thld | Alt 1 | Other | Cum | Thld | | Alt 1 | Other | Cum | Thld |
| Bridger WA | I | Black Joe | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 69.0 | 0.7 | 1.9 | 2.6 | 10 |
| | | Deep | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 61.0 | 0.8 | 2.1 | 2.9 | 10 |
| | | Hobbs | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.01 | 0.02 | 3 | 68.0 | 0.4 | 1.1 | 1.5 | 10 |
| | | Upper Frozen | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 5.8 ^a | 0.5 ^a | 1.3^a | 1.8^a | 1 ^a |
| Fitzpatrick WA | I | Ross | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.02 | 3 | 61.4 | 0.5 | 1.6 | 2.1 | 10 |
| Absaroka- Beartooth WA | II | Stepping Stone | <0.01 | 0.02 | 0.02 | 5 | 0.01 | 0.03 | 0.03 | 3 | 27.0 | 0.3 | 2.2 | 2.5 | 10 |
| | | Twin Island | <0.01 | 0.02 | 0.02 | 5 | 0.01 | 0.03 | 0.03 | 3 | 36.0 | 0.2 | 1.6 | 1.8 | 10 |
| Cloud Peak WA | II | Emerald | <0.01 | 0.03 | 0.03 | 5 | 0.04 | 0.07 | 0.10 | 3 | 53.3 | 1.7 | 4.2 | 5.9 | 10 |
| | | Florence | <0.01 | 0.03 | 0.03 | 5 | 0.04 | 0.07 | 0.11 | 3 | 32.7 | 3.1 | 7.2 | 10.4^b | 10 ^b |
| Popo Agie WA | II | Lower Saddlebag | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.04 | 3 | 55.5 | 1.0 | 2.6 | 3.6 | 10 |

Alt 1 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 1 impacts.

Other -Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining in the Wyoming and Montana PRB the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt 1** and **Other** impacts.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from USDA-FS (2000).

WA - Wilderness Area.

^a Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 µeq/L, the applicable significance threshold is less than a 1.0 µeq/L change. This threshold is exceeded by **Other** and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

^b Potential changes in acid neutralizing capacity is predicted to exceed the applicable significance level by less than one percent due to **Cum** emission sources.

Table E-7. Wyoming PRB Oil and Gas Project EIS Alternative 1 - Daily FLAG Refined Method - Visibility Impact Analysis (number of days $\times 1.0$ dv per year).

| Sensitive Location | PSD Classification | Alt 1 | Other | Cum |
|----------------------------|---------------------------|-------|-----------|-----------|
| Badlands WA | mandatory federal Class I | 3 | 13 to 17 | 24 to 28 |
| Bridger WA | mandatory federal Class I | 4 | 7 to 9 | 10 to 12 |
| Fitzpatrick WA | mandatory federal Class I | 4 | 6 to 9 | 10 to 12 |
| Gates of the Mountains WA | mandatory federal Class I | 0 | 3 to 4 | 4 to 4 |
| Grand Teton NP | mandatory federal Class I | 1 | 3 to 5 | 6 to 8 |
| North Absaroka WA | mandatory federal Class I | 4 | 9 to 13 | 12 to 15 |
| Red Rock Lakes WA | mandatory federal Class I | 0 | 0 to 1 | 1 to 3 |
| Scapegoat WA | mandatory federal Class I | 0 | 2 to 2 | 3 to 3 |
| Teton WA | mandatory federal Class I | 3 | 6 to 9 | 10 to 11 |
| Theodore Roosevelt NMP (N) | mandatory federal Class I | 0 | 0 to 1 | 2 to 3 |
| Theodore Roosevelt NMP (S) | mandatory federal Class I | 1 | 1 to 3 | 4 to 7 |
| U.L. Bend WA | mandatory federal Class I | 1 | 4 to 5 | 6 to 8 |
| Washakie WA | mandatory federal Class I | 5 | 10 to 14 | 15 to 18 |
| Wind Cave NP | mandatory federal Class I | 4 | 17 to 21 | 28 to 32 |
| Yellowstone NP | mandatory federal Class I | 3 | 8 to 11 | 11 to 13 |
| Fort Peck IR | Tribal designated Class I | 0 | 1 to 3 | 2 to 5 |
| Northern Cheyenne IR | Tribal designated Class I | 17 | 27 to 82 | 42 to 92 |
| Absaroka-Beartooth WA | federal Class II | 4 | 28 to 32 | 30 to 33 |
| Agate Fossil Beds NM | federal Class II | 2 | 8 to 11 | 15 to 19 |
| Bighorn Canyon NRA | federal Class II | 9 | 17 to 30 | 23 to 34 |
| Black Elk WA | federal Class II | 4 | 17 to 20 | 26 to 31 |
| Cloud Peak WA | federal Class II | 13 | 17 to 30 | 30 to 39 |
| Crow IR | federal Class II | 20 | 59 to 108 | 69 to 116 |
| Devils Tower NM | federal Class II | 9 | 17 to 25 | 39 to 47 |
| Fort Belknap IR | federal Class II | 1 | 60 to 61 | 61 to 62 |
| Fort Laramie NHS | federal Class II | 2 | 10 to 14 | 17 to 20 |
| Jewel Cave NM | federal Class II | 4 | 19 to 23 | 32 to 36 |
| Mount Rushmore NMem | federal Class II | 3 | 13 to 17 | 22 to 26 |
| Popo Agie WA | federal Class II | 4 | 7 to 9 | 10 to 13 |
| Soldier Creek WA | federal Class II | 2 | 10 to 13 | 18 to 21 |

Alt 1 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 1 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining operations in the Montana and Wyoming PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (high).

Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur at different locations.

Locations: **IR** - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument. **NMP** - National Memorial Park. **NMem** - National Memorial. **NP** - National Park. **NRA** - National Recreation Area. **WA** - Wilderness Area.

Table E-8. Wyoming PRB Oil and Gas Project EIS Alternative 2A - Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$).

| Pollutant | Avg Time ^a | Location | Increment | Alt 2A | Other | Cum | Background | Total | National | Wyoming |
|-------------------|-----------------------|------------------------|------------|--------|-------------------------|--------------------------|------------|-------|----------|---------|
| carbon monoxide | 1-hour | near-field | - - - | 158 | 142 | 197 | 3,500 | 3,697 | 40,000 | 40,000 |
| | | far-field ¹ | - - - | 4 | 100 | 100 | 3,500 | 3,600 | 40,000 | 40,000 |
| | 8-hours | near-field | - - - | 93 | 124 | 132 | 1,500 | 1,632 | 10,000 | 10,000 |
| | | far-field ² | - - - | 14 | 70 | 76 | 1,500 | 1,576 | 10,000 | 10,000 |
| nitrogen dioxide | Annual | near-field | 25 | 7.2 | 3.3 | 9.6 | 17 | 27 | 100 | 100 |
| | | far-field ³ | 25 | 0.4 | 5.1 | 5.4 | 17 | 22 | 100 | 100 |
| | | far-field ² | 2.5 | 0.2 | 3.9 ^b | 4.1 ^b | 17 | 21 | 100 | 100 |
| PM _{2.5} | 24-hours | near-field | - - - | 13.0 | 8.6 | 21.3 | 19 | 40 | 65 | 65 |
| | | far-field ³ | - - - | 4.5 | 9.7 | 14.0 | 19 | 33 | 65 | 65 |
| | Annual | near-field | - - - | 1.5 | 0.7 | 2.1 | 8 | 10 | 15 | 15 |
| | | far-field ³ | - - - | 0.2 | 1.1 | 1.2 | 8 | 9 | 15 | 15 |
| PM ₁₀ | 24-hours | near-field | 30 | 17.5 | 9.3 | 27.7 | 42 | 70 | 150 | 150 |
| | | far-field ⁴ | 30 | 0.4 | 29.7 | 29.7 | 42 | 72 | 150 | 150 |
| | | far-field ² | 8 | 3.4 | 9.4 ^b | 12.4 ^b | 42 | 54 | 150 | 150 |
| | | far-field ⁵ | 8 | 1.8 | 7.0 | 8.8 ^b | 42 | 51 | 150 | 150 |
| | Annual | near-field | 7 | 3.1 | 0.9 | 3.9 | 17 | 21 | 50 | 50 |
| | | far-field ⁴ | 17 | <0.1 | 2.7 | 2.7 | 17 | 20 | 50 | 50 |
| sulfur dioxide | 3-hours | near-field | 512 | 3.3 | 4.5 | 4.6 | 8 | 13 | 1,300 | 1,300 |
| | | far-field ³ | 512 | 0.7 | 17.1 | 17.1 | 8 | 25 | 1,300 | 1,300 |
| | 24-hours | near-field | 91 | 1.7 | 1.8 | 3.2 | 8 | 11 | 365 | 260 |
| | | far-field ³ | 91 | 0.3 | 5.3 | 5.3 | 8 | 13 | 365 | 260 |
| | Annual | near-field | 20 | 0.5 | 0.2 | 0.6 | 3 | 4 | 80 | 60 |
| | | far-field ³ | 20 | <0.1 | 0.4 | 0.4 | 3 | 3 | 80 | 60 |

^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2A**, including projected surface coal mining operations in the Montana and Wyoming PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 2A** and **Other** impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

Table E-9. Wyoming PRB Oil and Gas Project EIS Alternative 2A - Predicted Atmospheric Deposition Impacts and Applicable Significance Guidelines.

| Location | PSD Class | Lake | Total Sulfur Deposition (kg/ha-yr) | | | | Total Nitrogen Deposition (kg/ha-yr) | | | | Acid Neutralizing Capacity (percent) | | | | |
|-----------------------|-----------|-----------------|------------------------------------|-------|------|------|--------------------------------------|-------|------|------|--------------------------------------|------------------|------------------|------------------|----------------|
| | | | Alt 2A | Other | Cum | Thld | Alt 2A | Other | Cum | Thld | Bkgd (µeq/L) | Alt 2A | Other | Cum | Thld |
| Bridger WA | I | Black Joe | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 69.0 | 0.6 | 1.9 | 2.5 | 10 |
| | | Deep | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 61.0 | 0.7 | 2.1 | 2.8 | 10 |
| | | Hobbs | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.01 | 0.02 | 3 | 68.0 | 0.3 | 1.1 | 1.5 | 10 |
| | | Upper Frozen | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 5.8 ^a | 0.5 ^a | 1.3 ^a | 1.8 ^a | 1 ^a |
| Fitzpatrick WA | I | Ross | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.02 | 3 | 61.4 | 0.5 | 1.6 | 2.0 | 10 |
| Absaroka-Beartooth WA | II | Stepping Stone | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 27.0 | 0.3 | 2.2 | 2.5 | 10 |
| | | Twin Island | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 36.0 | 0.2 | 1.6 | 1.8 | 10 |
| Cloud Peak WA | II | Emerald | <0.01 | 0.03 | 0.03 | 5 | 0.03 | 0.07 | 0.10 | 3 | 53.3 | 1.5 | 4.2 | 5.7 | 10 |
| | | Florence | <0.01 | 0.03 | 0.03 | 5 | 0.03 | 0.07 | 0.10 | 3 | 32.7 | 2.8 | 7.2 | 10.0 | 10 |
| Popo Agie WA | II | Lower Saddlebag | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 55.5 | 0.9 | 2.6 | 3.5 | 10 |

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2A**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt 2A** and **Other** impacts.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from USDA-FS (2000).

WA - Wilderness Area.

^a Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 µeq/L, the applicable significance threshold is less than a 1.0 µeq/L change. This threshold is exceeded by **Other** and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

Table E-10. Wyoming PRB Oil and Gas EIS Alternative 2A - Daily FLAG Refined Method - Visibility Impact Analysis (number of days $\times 1.0$ dv per year).

| Sensitive Location | PSD Classification | Alt 2A | Other | Cum |
|----------------------------|---------------------------|--------|-----------|-----------|
| Badlands WA | mandatory federal Class I | 3 | 13 to 17 | 24 to 27 |
| Bridger WA | mandatory federal Class I | 4 | 7 to 9 | 10 to 12 |
| Fitzpatrick WA | mandatory federal Class I | 3 | 6 to 9 | 9 to 12 |
| Gates of the Mountains WA | mandatory federal Class I | 0 | 3 to 4 | 4 to 4 |
| Grand Teton NP | mandatory federal Class I | 1 | 3 to 5 | 6 to 7 |
| North Absaroka WA | mandatory federal Class I | 3 | 9 to 13 | 12 to 14 |
| Red Rock Lakes WA | mandatory federal Class I | 0 | 0 to 1 | 1 to 3 |
| Scapegoat WA | mandatory federal Class I | 0 | 2 to 2 | 2 to 3 |
| Teton WA | mandatory federal Class I | 3 | 6 to 9 | 9 to 11 |
| Theodore Roosevelt NMP (N) | mandatory federal Class I | 0 | 0 to 1 | 2 to 3 |
| Theodore Roosevelt NMP (S) | mandatory federal Class I | 0 | 1 to 3 | 4 to 6 |
| U.L. Bend WA | mandatory federal Class I | 1 | 4 to 5 | 5 to 8 |
| Washakie WA | mandatory federal Class I | 4 | 10 to 14 | 14 to 18 |
| Wind Cave NP | mandatory federal Class I | 3 | 17 to 21 | 27 to 30 |
| Yellowstone NP | mandatory federal Class I | 2 | 8 to 11 | 11 to 13 |
| Fort Peck IR | Tribal designated Class I | 0 | 1 to 3 | 2 to 5 |
| Northern Cheyenne IR | Tribal designated Class I | 16 | 27 to 82 | 39 to 91 |
| Absaroka-Beartooth WA | federal Class II | 3 | 28 to 32 | 29 to 33 |
| Agate Fossil Beds NM | federal Class II | 1 | 8 to 11 | 14 to 17 |
| Bighorn Canyon NRA | federal Class II | 8 | 17 to 30 | 22 to 34 |
| Black Elk WA | federal Class II | 3 | 17 to 20 | 25 to 29 |
| Cloud Peak WA | federal Class II | 12 | 17 to 30 | 28 to 38 |
| Crow IR | federal Class II | 16 | 59 to 108 | 69 to 115 |
| Devils Tower NM | federal Class II | 6 | 17 to 25 | 36 to 44 |
| Fort Belknap IR | federal Class II | 1 | 60 to 61 | 61 to 61 |
| Fort Laramie NHS | federal Class II | 2 | 10 to 14 | 17 to 19 |
| Jewel Cave NM | federal Class II | 3 | 19 to 23 | 30 to 35 |
| Mount Rushmore Nmem | federal Class II | 2 | 13 to 17 | 21 to 25 |
| Popo Agie WA | federal Class II | 3 | 7 to 9 | 10 to 12 |
| Soldier Creek WA | federal Class II | 1 | 10 to 13 | 17 to 21 |

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in Wyoming PRB Oil and Gas Project EIS **Alt 2A**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (high).

Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt 2A** and **Other** impacts, which can occur at different locations.

Locations: **IR** - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument. **NMP** - National Memorial Park. **NMem** - National Memorial. **NP** - National Park. **NRA** - National Recreation Area. **WA** - Wilderness Area.

Table E-11. Wyoming PRB Oil and Gas Project EIS Alternative 2B - Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$).

| Pollutant | Avg Time ^a | Location | Increment | Alt 2B | Other | Cum | Background | Total | National | Wyoming |
|-------------------|-----------------------|------------------------|-----------------------|--------|------------------|--------------------------|------------|-------|----------|---------|
| carbon monoxide | 1-hour | near-field | - - - | 157 | 142 | 170 | 3,500 | 3,670 | 40,000 | 40,000 |
| | | far-field ¹ | - - - | 3 | 100 | 100 | 3,500 | 3,600 | 40,000 | 40,000 |
| | 8-hours | near-field | - - - | 77 | 124 | 124 | 1,500 | 1,624 | 10,000 | 10,000 |
| | | far-field ² | - - - | 9 | 70 | 74 | 1,500 | 1,574 | 10,000 | 10,000 |
| nitrogen dioxide | Annual | near-field | 25 | 6.3 | 3.3 | 8.8 | 17 | 26 | 100 | 100 |
| | | far-field ³ | 25 | 0.3 | 5.1 | 5.3 | 17 | 22 | 100 | 100 |
| | | far-field ² | 2.5 | 0.2 | 3.9 ^b | 4.1 ^b | 17 | 21 | 100 | 100 |
| PM _{2.5} | 24-hours | near-field | - - - | 10.7 | 8.6 | 19.0 | 19 | 38 | 65 | 65 |
| | | far-field ³ | - - - | 3.8 | 9.7 | 13.4 | 19 | 32 | 65 | 65 |
| | Annual | near-field | - - - | 1.3 | 0.7 | 2.0 | 8 | 10 | 15 | 15 |
| | | far-field ³ | - - - | 0.1 | 1.1 | 1.2 | 8 | 9 | 15 | 15 |
| PM ₁₀ | 24-hours | near-field | 30 | 15.2 | 9.3 | 25.5 | 42 | 67 | 150 | 150 |
| | | far-field ⁴ | 30 | 0.4 | 29.7 | 29.7 | 42 | 72 | 150 | 150 |
| | | far-field ² | 8 ^b | 3.0 | 9.4 ^b | 12.1 ^b | 42 | 54 | 150 | 150 |
| | | far-field ⁵ | 8 | 1.5 | 7.0 | 8.5 ^b | 42 | 50 | 150 | 150 |
| | Annual | near-field | 17 | 2.9 | 0.9 | 3.7 | 17 | 21 | 50 | 50 |
| | | far-field ⁴ | 17 | <0.1 | 2.7 | 2.7 | 17 | 20 | 50 | 50 |
| sulfur dioxide | 3-hours | near-field | 512 | 3.3 | 4.5 | 4.6 | 8 | 13 | 1,300 | 1,300 |
| | | far-field ³ | 512 | 0.7 | 17.1 | 17.1 | 8 | 25 | 1,300 | 1,300 |
| | 24-hours | near-field | 91 | 1.7 | 1.8 | 3.2 | 8 | 11 | 365 | 260 |
| | | far-field ³ | 91 | 0.3 | 5.3 | 5.3 | 8 | 13 | 365 | 260 |
| | Annual | near-field | 20 | 0.5 | 0.2 | 0.6 | 3 | 4 | 80 | 60 |
| | | far-field ³ | 20 | <0.1 | 0.4 | 0.4 | 3 | 3 | 80 | 60 |

^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 2B - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2B impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 2B** and **Other** impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

¹ Absaroka-Beartooth Wilderness Area

² Northern Cheyenne Indian Reservation

³ Crow Indian Reservation

⁴ Fort Belknap Indian Reservation

⁵ Washakie Wilderness Area

Table E-12. Wyoming PRB Oil and Gas Project EIS Alternative 2B - Predicted Atmospheric Deposition Impacts and Applicable Significance Thresholds.

| Location | PSD Class | Lake | Total Sulfur Deposition (kg/ha-yr) | | | | Total Nitrogen Deposition (kg/ha-yr) | | | | Acid Neutralizing Capacity (percent) | | | | |
|-----------------------|-----------|-----------------|------------------------------------|-------|------|------|--------------------------------------|-------|------|------|--------------------------------------|------------------|------------------|------------------|----------------|
| | | | Alt 2B | Other | Cum | Thld | Alt 2B | Other | Cum | Thld | Bkgd (µeq/L) | Alt 2B | Other | Cum | Thld |
| Bridger WA | I | Black Joe | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 69.0 | 0.6 | 1.9 | 2.4 | 10 |
| | | Deep | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 61.0 | 0.6 | 2.1 | 2.7 | 10 |
| | | Hobbs | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.01 | 0.02 | 3 | 68.0 | 0.3 | 1.1 | 1.4 | 10 |
| | | Upper Frozen | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 5.8 ^a | 0.4 ^a | 1.3 ^a | 1.7 ^a | 1 ^a |
| Fitzpatrick WA | I | Ross | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.02 | 3 | 61.4 | 0.4 | 1.6 | 2.0 | 10 |
| Absaroka-Beartooth WA | II | Stepping Stone | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 27.0 | 0.2 | 2.2 | 2.5 | 10 |
| | | Twin Island | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 36.0 | 0.2 | 1.6 | 1.8 | 10 |
| Cloud Peak WA | II | Emerald | <0.01 | 0.03 | 0.03 | 5 | 0.03 | 0.07 | 0.10 | 3 | 53.3 | 1.3 | 4.2 | 5.5 | 10 |
| | | Florence | <0.01 | 0.03 | 0.03 | 5 | 0.03 | 0.07 | 0.10 | 3 | 32.7 | 2.5 | 7.2 | 9.7 | 10 |
| Popo Agie WA | II | Lower Saddlebag | <0.01 | 0.01 | 0.01 | 5 | 0.01 | 0.02 | 0.03 | 3 | 55.5 | 0.8 | 2.6 | 3.4 | 10 |

Alt 2B - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2B impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt 2B** and **Other** impacts.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from USDA-FS (2000).

WA- Wilderness Area.

^a Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 µeq/L, the applicable significance threshold is less than a 1.0 µeq/L change. This threshold is exceeded by **Other** sources alone, as well **Cum** sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

Table E-13. Wyoming PRB Oil and Gas Project EIS Alternative 2B - Daily FLAG Refined Method - Visibility Impact Analysis (number of days ≥ 1.0 dv per year).

| Sensitive Location | PSD Classification | Alt 2B | Other | Cum |
|----------------------------|---------------------------|--------|-----------|-----------|
| Badlands WA | mandatory federal Class I | 1 | 13 to 17 | 22 to 26 |
| Bridger WA | mandatory federal Class I | 3 | 7 to 9 | 9 to 11 |
| Fitzpatrick WA | mandatory federal Class I | 3 | 6 to 9 | 9 to 11 |
| Gates of the Mountains WA | mandatory federal Class I | 0 | 3 to 4 | 4 to 4 |
| Grand Teton NP | mandatory federal Class I | 0 | 3 to 5 | 5 to 7 |
| North Absaroka WA | mandatory federal Class I | 2 | 9 to 13 | 12 to 14 |
| Red Rock Lakes WA | mandatory federal Class I | 0 | 0 to 1 | 1 to 2 |
| Scapegoat WA | mandatory federal Class I | 0 | 2 to 2 | 2 to 3 |
| Teton WA | mandatory federal Class I | 2 | 6 to 9 | 9 to 11 |
| Theodore Roosevelt NMP (N) | mandatory federal Class I | 0 | 0 to 1 | 1 to 3 |
| Theodore Roosevelt NMP (S) | mandatory federal Class I | 0 | 1 to 3 | 3 to 6 |
| U.L. Bend WA | mandatory federal Class I | 1 | 4 to 5 | 5 to 7 |
| Washakie WA | mandatory federal Class I | 4 | 10 to 14 | 14 to 17 |
| Wind Cave NP | mandatory federal Class I | 2 | 17 to 21 | 25 to 28 |
| Yellowstone NP | mandatory federal Class I | 1 | 8 to 11 | 11 to 13 |
| Fort Peck IR | Tribal designated Class I | 0 | 1 to 3 | 2 to 4 |
| Northern Cheyenne IR | Tribal designated Class I | 14 | 27 to 82 | 38 to 90 |
| Absaroka-Beartooth WA | federal Class II | 3 | 28 to 32 | 29 to 33 |
| Agate Fossil Beds NM | federal Class II | 0 | 8 to 11 | 3 to 16 |
| Bighorn Canyon NRA | federal Class II | 7 | 17 to 30 | 21 to 33 |
| Black Elk WA | federal Class II | 2 | 17 to 20 | 24 to 28 |
| Cloud Peak WA | federal Class II | 9 | 17 to 30 | 27 to 37 |
| Crow IR | federal Class II | 14 | 59 to 108 | 68 to 115 |
| Devils Tower NM | federal Class II | 5 | 17 to 25 | 34 to 42 |
| Fort Belknap IR | federal Class II | 1 | 60 to 61 | 61 to 61 |
| Fort Laramie NHS | federal Class II | 1 | 10 to 14 | 16 to 19 |
| Jewel Cave NM | federal Class II | 2 | 19 to 23 | 29 to 33 |
| Mount Rushmore Nmem | federal Class II | 1 | 13 to 17 | 21 to 24 |
| Popo Agie WA | federal Class II | 3 | 7 to 9 | 10 to 12 |
| Soldier Creek WA | federal Class II | 1 | 10 to 13 | 16 to 20 |

Alt 2B - Direct modeled Wyoming PRB Oil and Gas EIS Alternative 2B impacts.

Other- Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (high).

Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt 2B** and **Other** impacts, which can occur at different locations.

Locations: **IR** - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument. **NMP** - National Memorial Park. **NMem** - National Memorial. **NP** - National Park. **NRA** - National Recreation Area. **WA** - Wilderness Area.

Table E-14. Wyoming PRB Oil and Gas Project EIS Alternative 3 - Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$).

| Pollutant | Avg Time ^a | Location | Increment | Alt 3 | Other | Cum | Background | Total | National | Wyoming |
|-------------------|-----------------------|------------------------|------------|-------|-------------------------|--------------------------|------------|-------|----------|---------|
| carbon monoxide | 1-hour | near-field | - - - | 261 | 142 | 261 | 3,500 | 3,761 | 40,000 | 40,000 |
| | | far-field ¹ | - - - | 2 | 100 | 100 | 3,500 | 3,600 | 40,000 | 40,000 |
| | 8-hours | near-field | - - - | 183 | 124 | 183 | 1,500 | 1,683 | 10,000 | 10,000 |
| | | far-field ² | - - - | 8 | 70 | 75 | 1,500 | 1,575 | 10,000 | 10,000 |
| nitrogen dioxide | Annual | near-field | 25 | 3.0 | 3.3 | 5.8 | 17 | 23 | 100 | 100 |
| | | far-field ³ | 25 | 0.3 | 5.1 | 5.3 | 17 | 22 | 100 | 100 |
| | | far-field ² | 2.5 | 0.1 | 3.9 ^b | 4.1 ^b | 17 | 21 | 100 | 100 |
| PM _{2.5} | 24-hours | near-field | - - - | 5.7 | 8.6 | 13.5 | 19 | 32 | 65 | 65 |
| | | far-field ⁴ | - - - | 0.2 | 12.7 | 12.7 | 19 | 32 | 65 | 65 |
| | Annual | near-field | - - - | 0.7 | 0.7 | 1.3 | 8 | 9 | 15 | 15 |
| PM ₁₀ | 24-hours | far-field ⁴ | - - - | 0.0 | 1.2 | 1.2 | 8 | 9 | 15 | 15 |
| | | near-field | 30 | 7.1 | 9.3 | 15.6 | 42 | 58 | 150 | 150 |
| | | far-field ⁴ | 30 | 0.2 | 29.7 | 29.7 | 42 | 72 | 150 | 150 |
| | | far-field ² | 8 | 1.5 | 9.4 ^b | 10.7 ^b | 42 | 53 | 150 | 150 |
| | Annual | far-field ⁵ | 8 | 0.9 | 7.0 | 7.8 | 42 | 50 | 150 | 150 |
| | | near-field | 17 | 1.2 | 0.9 | 1.9 | 17 | 19 | 50 | 50 |
| | | far-field ⁴ | 7 | <0.1 | 2.7 | 2.7 | 17 | 20 | 50 | 50 |
| sulfur dioxide | 3-hours | near-field | 512 | 1.2 | 4.5 | 4.6 | 8 | 13 | 1,300 | 1,300 |
| | | far-field ³ | 512 | 0.3 | 17.1 | 17.1 | 8 | 25 | 1,300 | 1,300 |
| | 24-hours | near-field | 91 | 0.6 | 1.8 | 2.2 | 8 | 10 | 365 | 260 |
| | | far-field ³ | 91 | 0.1 | 5.3 | 5.3 | 8 | 13 | 365 | 260 |
| | Annual | near-field | 20 | 0.2 | 0.2 | 0.3 | 3 | 3 | 80 | 60 |
| | | far-field ³ | 20 | <0.1 | 0.4 | 0.4 | 3 | 3 | 80 | 60 |

^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 3** and **Other** impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

Table E-15. Wyoming PRB Oil and Gas Project EIS Alternative 3 - Predicted Atmospheric Deposition Impacts and Applicable Significance Thresholds.

| Location | PSD Class | Lake | Total Sulfur Deposition (kg/ha-yr) | | | | Total Nitrogen Deposition (kg/ha-yr) | | | | Acid Neutralizing Capacity (percent) | | | | |
|-----------------------|-----------|-----------------|------------------------------------|-------|------|------|--------------------------------------|-------|------|------|--------------------------------------|------------------|-------------------------|-------------------------|-----------------------|
| | | | Alt 3 | Other | Cum | Thld | Alt 3 | Other | Cum | Thld | Bkgd (µeq/L) | Alt 3 | Other | Cum | Thld |
| Bridger WA | I | Black Joe | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.02 | 0.03 | 3 | 69.0 | 0.3 | 1.9 | 2.1 | 10 |
| | | Deep | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.02 | 0.02 | 3 | 61.0 | 0.3 | 2.1 | 2.4 | 10 |
| | | Hobbs | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.01 | 0.02 | 3 | 68.0 | 0.2 | 1.1 | 1.3 | 10 |
| | | Upper Frozen | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.02 | 0.02 | 3 | 5.8 ^a | 0.2 ^a | 1.3 ^a | 1.5 ^a | 1 ^a |
| Fitzpatrick WA | I | Ross | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.02 | 0.02 | 3 | 61.4 | 0.2 | 1.6 | 1.7 | 10 |
| Absaroka-Beartooth WA | II | Stepping Stone | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 27.0 | 0.1 | 2.2 | 2.4 | 10 |
| | | Twin Island | <0.01 | 0.02 | 0.02 | 5 | <0.01 | 0.03 | 0.03 | 3 | 36.0 | 0.1 | 1.6 | 1.7 | 10 |
| Cloud Peak WA | II | Emerald | <0.01 | 0.03 | 0.03 | 5 | 0.01 | 0.07 | 0.08 | 3 | 53.3 | 0.7 | 4.2 | 4.9 | 10 |
| | | Florence | <0.01 | 0.03 | 0.03 | 5 | 0.02 | 0.07 | 0.08 | 3 | 32.7 | 1.3 | 7.2 | 8.5 | 10 |
| Popo Agie WA | II | Lower Saddlebag | <0.01 | 0.01 | 0.01 | 5 | <0.01 | 0.02 | 0.03 | 3 | 55.5 | 0.4 | 2.6 | 3.0 | 10 |

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt 3** and **Other** impacts.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from USDA-FS (2000).

WA - Wilderness Area.

^a Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 µeq/L, the applicable significance threshold is less than a 1.0 µeq/L change. This threshold is exceeded by **Other** sources alone, as well **Cum** sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

Table E-16. Wyoming PRB Oil and Gas Project EIS Alternative 3 - Daily FLAG Refined Method - Visibility Impact Analysis (number of days $\times 1.0$ dv per year).

| Sensitive Location | PSD Classification | Alt 3 | Other | Cum |
|----------------------------|---------------------------|-------|-----------|-----------|
| Badlands WA | mandatory federal Class I | 0 | 13 to 17 | 18 to 21 |
| Bridger WA | mandatory federal Class I | 1 | 7 to 9 | 8 to 10 |
| Fitzpatrick WA | mandatory federal Class I | 1 | 6 to 9 | 8 to 10 |
| Gates of the Mountains WA | mandatory federal Class I | 0 | 3 to 4 | 3 to 4 |
| Grand Teton NP | mandatory federal Class I | 0 | 3 to 5 | 4 to 6 |
| North Absaroka WA | mandatory federal Class I | 0 | 9 to 13 | 11 to 13 |
| Red Rock Lakes WA | mandatory federal Class I | 0 | 0 to 1 | 0 to 2 |
| Scapegoat WA | mandatory federal Class I | 0 | 2 to 2 | 2 to 3 |
| Teton WA | mandatory federal Class I | 0 | 6 to 9 | 7 to 10 |
| Theodore Roosevelt NMP (N) | mandatory federal Class I | 0 | 0 to 1 | 1 to 2 |
| Theodore Roosevelt NMP (S) | mandatory federal Class I | 0 | 1 to 3 | 2 to 4 |
| U.L. Bend WA | mandatory federal Class I | 0 | 4 to 5 | 5 to 6 |
| Washakie WA | mandatory federal Class I | 1 | 10 to 14 | 12 to 16 |
| Wind Cave NP | mandatory federal Class I | 0 | 17 to 21 | 22 to 25 |
| Yellowstone NP | mandatory federal Class I | 0 | 8 to 11 | 9 to 12 |
| Fort Peck IR | Tribal designated Class I | 0 | 1 to 3 | 2 to 4 |
| Northern Cheyenne IR | Tribal designated Class I | 7 | 27 to 82 | 33 to 87 |
| Absaroka-Beartooth WA | federal Class II | 0 | 28 to 32 | 28 to 32 |
| Agate Fossil Beds NM | federal Class II | 0 | 8 to 11 | 10 to 14 |
| Bighorn Canyon NRA | federal Class II | 3 | 17 to 30 | 19 to 32 |
| Black Elk WA | federal Class II | 0 | 17 to 20 | 20 to 24 |
| Cloud Peak WA | federal Class II | 3 | 17 to 30 | 23 to 35 |
| Crow IR | federal Class II | 10 | 59 to 108 | 65 to 113 |
| Devils Tower NM | federal Class II | 1 | 17 to 25 | 26 to 34 |
| Fort Belknap IR | federal Class II | 0 | 60 to 61 | 61 to 61 |
| Fort Laramie NHS | federal Class II | 0 | 10 to 14 | 13 to 16 |
| Jewel Cave NM | federal Class II | 0 | 19 to 23 | 24 to 28 |
| Mount Rushmore NMem | federal Class II | 0 | 13 to 17 | 17 to 20 |
| Popo Agie WA | federal Class II | 1 | 7 to 9 | 8 to 11 |
| Soldier Creek WA | federal Class II | 0 | 10 to 13 | 13 to 16 |

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (high).

Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt 3** and **Other** impacts, which can occur at different locations.

Locations: **IR** - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument. **NMP** - National Memorial Park. **NMem** - National Memorial. **NP** - National Park. **NRA** - National Recreation Area. **WA** - Wilderness Area.

Table E-17. Predicted Visibility Impacts in Class I Areas - Daily FLAG Refined Method (Maximum cumulative deciview change).

| Class I area | Alt 1 | Alt 2 | Alt 2b | Alt 3 |
|--|-------|-------|--------|-------|
| Badlands Wilderness Area ¹ | 10.91 | 10.67 | 10.43 | 9.46 |
| Bridger Wilderness Area | 13.28 | 12.67 | 12.21 | 11.15 |
| Fitzpatrick Wilderness Area | 16.57 | 15.83 | 15.21 | 14.01 |
| Gates of the Mtns Wilderness Area | 14.99 | 14.61 | 14.22 | 13.17 |
| Grand Teton National Park | 6.95 | 6.67 | 6.44 | 5.8 |
| North Absaroka Wilderness Area | 14.89 | 14.12 | 13.51 | 12.21 |
| Red Rock Lakes Wilderness Area | 2.85 | 2.75 | 2.67 | 2.37 |
| Sagegoat Wilderness Area | 9.89 | 9.58 | 9.35 | 8.55 |
| Teton Wilderness Area | 14.59 | 13.97 | 13.46 | 12.38 |
| Theodore Roosevelt NMP ² (North Unit) | 3.65 | 3.46 | 3.29 | 2.75 |
| Theodore Roosevelt NMP ² (South Unit) | 4.62 | 4.37 | 4.14 | 3.51 |
| U.L. Bend Wilderness Area | 29.05 | 27.97 | 26.97 | 24.01 |
| Washakie Wilderness Area | 24.79 | 23.82 | 22.96 | 21.48 |
| Wind Cave National Park | 9.05 | 8.81 | 8.59 | 8.06 |
| Yellowstone National Park | 12.79 | 12.19 | 11.59 | 10.25 |
| Northern Cheyenne Reservation ³ | 54.75 | 52.8 | 50.71 | 45.02 |

¹ The U.S. Congress designated the Wilderness Area portion of Badlands National Park as a mandatory federal PSD Class I area. The remainder of Badlands National Park is a PSD Class II area.

² NMP – National Memorial Park.

³ Although the Northern Cheyenne Reservation is a tribal designated PSD Class I Area, it is not a mandatory federal PSD Class I area subject to EPA's Regional Haze Regulations.

Mitigation Options

Mitigation may be applied to fugitive dust and nitrogen oxide (NO_x) impacts. Fugitive dust refers to any particulate matter that is not deliberately emitted by a well-defined source. Fugitive dust sources typically include windblown dust from unvegetated lands and unpaved roads. Table E-18 shows several fugitive dust mitigation options available. Other mitigation measures that are utilized by surface coal mines in Wyoming to control fugitive dust emissions are listed in Section 3.5.5.3 of this EIS.

Nitrogen oxide emissions are associated with combustion. Table E-19 shows several options available to mitigate NO_x impacts related to production of oil and gas, including CBM. Mitigation measures that the mines have instituted or that WDEQ may require related to coal mining operations are listed in Section 3.5.6.3 of this EIS.

Table E-18. Fugitive Dust Mitigation Measures (PM₁₀), Effectiveness and Cost.

| | Dust Sources | | | | | |
|--------------------|---|---|--------------------------------------|--|----------------------|---------------------------|
| | Disturbed Areas | Unpaved Roads¹ | | | | |
| Mitigation Options | Establish plant cover for all disturbed lands by certain time (re-vegetation) | Water roads to attain certain percent moisture ² | Apply soil stabilizer | Set and enforce speed limit | Gravel roads | Pave road |
| Effectiveness | Level proportional to percentage of land cover | 0 - 50 percent reduction in uncontrolled dust emissions | 33 to 100 percent control efficiency | 80 percent for 15 mph ³ 65 percent for 20 mph ³ 25 percent for 30 mph ³ | 30 percent reduction | 90 percent reduction |
| Estimated Cost | | \$4000/mile | \$2,000 to \$4,000/mile per year | Unknown | \$9,000/mile | \$11,000 to \$60,000/mile |

¹ Improved and County roads.

² Wetting of construction roads during the construction period. Wetting of construction roads not required for once a month maintenance trips to well pads.

³ Reductions assume 40 mile per hour base speed.

Table E-19. Nitrogen Oxides (NO_x) Mitigation Measures Efficiency.

| | NO_x Emissions Sources | | | |
|-------------------------------|---|---|---|---------------------------------|
| | Field Compressors | Sales Compressors | Temporary Diesel Generators¹ | |
| Mitigation Options/Efficiency | Implement Best Available Control Technology Typically results in a NO _x emission rate of about 1 g/bhp-hr | Implement Best Available Control Technology Typically results in a NO _x emission rate of about 1 g/bhp-hr | Register with State; WDEQ regulate as appropriate | Voluntary use of diesel engines |

¹ Wyoming is currently registering these generators to determine if NO_x emissions are significant.

² BACT could include electric compression.